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NATIONAL DAM INSPECTION PROGRAM, MARTINS DAM, (NDS ID-PA-00620,--ETC(U)
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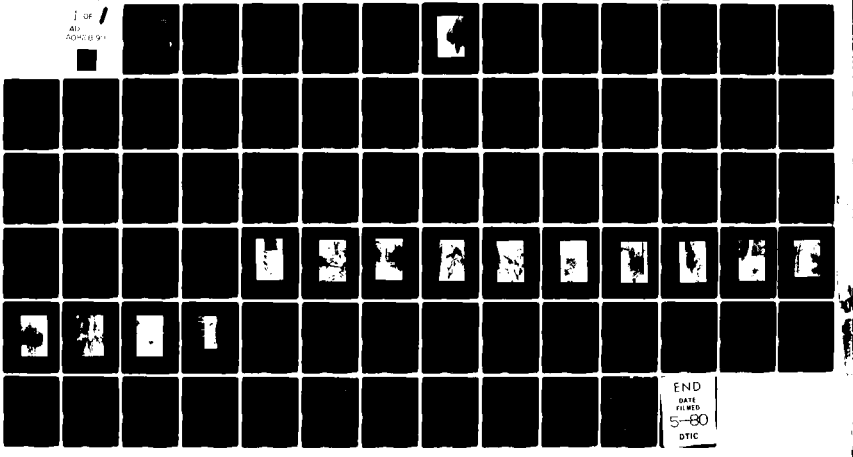

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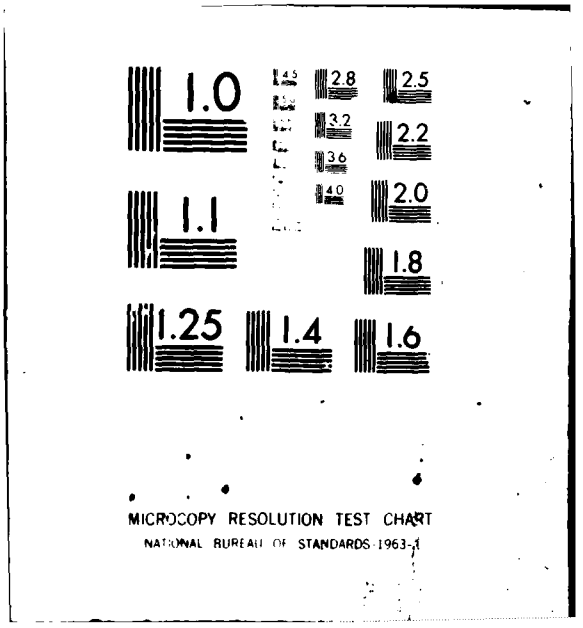
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DELAWARE RIVER BASIN
CROW CREEK, MONTGOMERY COUNTY

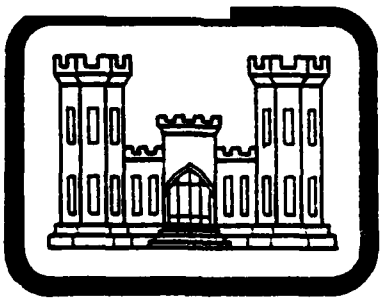
PENNSYLVANIA
NDS ID PA. 00620
DER ID 46-145

LEVEL II

MARTINS DAM

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DACW31-80-C-0018



DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

JANUARY 1980

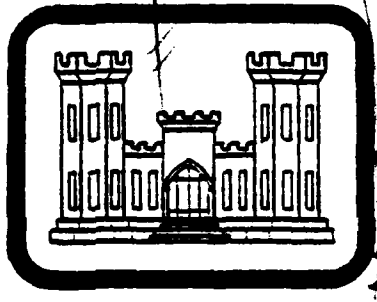
DELAWARE RIVER BASIN

(12) 782

MARTINS DAM
MONTGOMERY COUNTY, PENNSYLVANIA

NDS I.D. NO. PA 00620
DER I.D. NO. 46-145

(6) PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM • Martin's Dam, (NDS ID-PA-00620, DER ID-46-145), Delaware River Basin, Crow Creek (Abrams Run), Montgomery County, Pennsylvania; Phase I Inspection Report.



Prepared by:

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(15) DACW 31-80-C-0018

Submitted to:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to expeditiously identify those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Martins Dam
County Located:	Montgomery County
State Located:	Pennsylvania
Stream:	Crow Creek (Abrams Run)
Coordinates:	Latitude 40° 4.2'
	Longitude 75° 23.6'
Date of Inspection:	November 12, 1979

Martins Dam, built sometime before 1886, is owned by Martins Dam Club. The dam and reservoir were formerly used for recreation, but currently have no use. As a state highway, Croton Road (LR 144), crosses the dam breast, the roadway and the shoulders are maintained by the Pennsylvania Department of Transportation.

The dam and its appurtenant facilities are considered to be in fair condition. The dam is classified as a "Small" size structure with a "High" hazard classification, consistent with its potential in the event of failure for extensive property damage and loss of life downstream in the King of Prussia Mall.

Calculations indicate that the existing spillway system is not capable of passing about 0.1 PMF (Probable Maximum Flood) without overtopping. It is assessed that 0.5 PMF would cause failure and significantly increase the potential for excessive property damage and loss of life in the major downstream damage center, King of Prussia Mall. Therefore, the spillway system of this structure is considered to be "Seriously Inadequate", and the dam is in an "unsafe, nonemergency" condition.

The visual inspection and review of available documentation indicates that the dam, foundation and its appurtenant structures are in fair condition. The items to be noted are some deterioration of the spillway inlet and large trees growing on both upstream and downstream slopes of the embankment.

It is recommended that the following measures be taken immediately. All work should be done under the supervision of a registered professional engineer experienced in the design of dams.

1. A detailed hydrologic/hydraulic study should be made to determine the best method of increasing the

spillway capacity to meet current hydrologic/ hydraulic criteria.

2. The large trees on both the upstream and downstream slopes of the embankment should be removed. However, the long-term stability of the slopes should be evaluated in light of decaying root systems.

3. Consideration should be given to improving access to the pond drain valve and to making operational the second reservoir drain, shown in the 1939 photograph (Photograph No. 14, Appendix C).

Because of the location of the dam and the potential for heavy property damage and possible loss of life in the event of failure, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning downstream residents and particularly the King of Prussia Mall that high flows are expected and provisions for evacuating these people in the event of an emergency. In addition, a formal agreement between Martins Dam Club and the Pennsylvania Department of Transportation should be made delineating maintenance responsibility. An operation and maintenance procedure should also be developed to insure that all pertinent items are carefully inspected on a regular basis and maintained in the best possible condition.

Mary F. Beck — Feb. 7, 1980

Mary F. Beck, P.E. — Date
Pennsylvania Registration 27447E
Woodward-Clyde Consultants

STATE OF MARYLAND — John Henry Frederick, Jr. No. 7301 — REGISTERED PROFESSIONAL ENGINEER

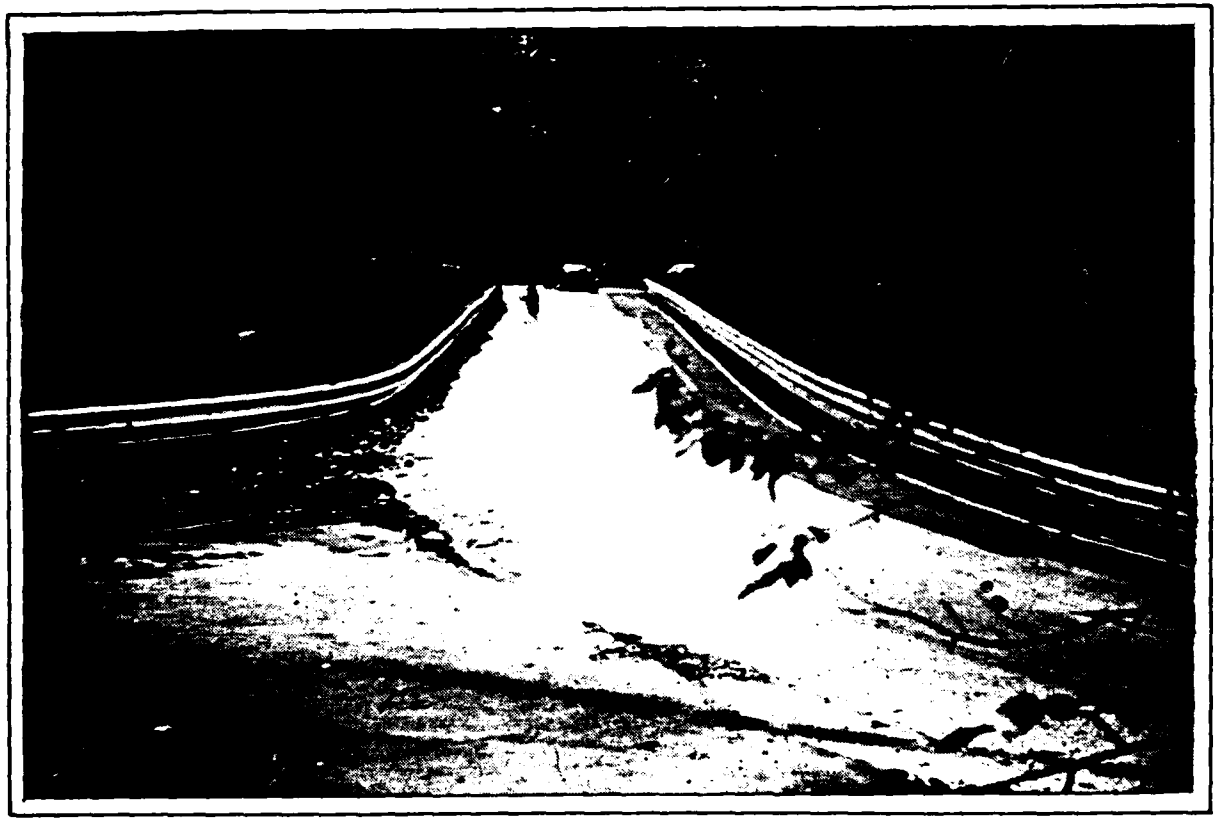
2/7/80

John H. Frederick, Jr., P.E. — Date
Maryland Registration 7301
Woodward-Clyde Consultants

APPROVED BY:

20 March 80

THOMAS A. RHEN — Date
LTC, Corps of Engineers
Acting District Engineer



OVERVIEW
MARTINS DAM, MONTGOMERY COUNTY, PENNSYLVANIA

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
MARTINS DAM
NATIONAL ID NO. PA 00620
DER NO. 46-145

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Martins Dam is an earth and masonry dam about 22.5 feet high and 260 feet long. Very limited data exists regarding the physical features of the dam. At the time of the November field inspection, the downstream slope ranged from vertical in the area of the spillway to approximately 1.66H:1V. The dam had been overtopped in September 1979, during Hurricane David, washing away a considerable portion of downstream rock fill at the maximum section and exposing the dry masonry interior of the dam, originally the downstream face of the dam. Erosion had also taken place at the left and right downstream abutment junctions, and a corrugated metal spillway extension was washed away. A state highway, Croton Road (LR 144), crosses the breast of the dam. The pavement was undermined by the overtopping and the guardrail posts were left unsupported. The crest is 21 feet wide and the upstream slope above the waterline is about 2H:1V.

The spillway is located at approximately the mid-point of the dam. The weir of the spillway inlet is at elevation 285.0. Discharge flows through a 36 inch diameter steel pipe whose outlet is at elevation 282.1. At the time of the inspection in November 1979, a 48 inch diameter corrugated metal spillway extension had washed away and was downstream, lying on dislodged rock fill. Water discharges from the steel pipe onto the rock and flows down into the channel. By January 1980, the corrugated metal extension was replaced.

About seven feet into the reservoir from the spillway entrance is a 6.5 foot square brick valve box. At the base of the valve box is a valve which controls the 12 inch pond drain. The outlet of this drain cannot be seen under the rock fill at the downstream toe.

In December 1979, the reservoir was lowered to facilitate repairs to the downstream face of the dam. The lower portion of a brick structure located in the reservoir, which formerly extended above the water level, was disclosed. The outlet of this drain (Photograph No. 14, Appendix C) cannot be located.

Plan and section views of the dam are included as Plates 2 and 3, Appendix E. Photograph No. 14, Appendix C, is of the downstream face of the dam as it appeared in 1939.

b. Location. The dam is located across Crow Creek, also known as Abrams Run, in Upper Merion Township, Montgomery County, Pennsylvania. The dam site is located approximately 0.85 mile south of the intersection of U.S. Route 202 and the Schuylkill Expressway (Interstate 76). The dam site and reservoir are located on the USGS Quadrangle map entitled "Valley Forge, Pennsylvania", at coordinates N 40° 4.2' W 75° 23.6'. A regional location plan of Martins Dam and reservoir is enclosed as Plate 1, Appendix E.

c. Size Classification. The dam is classified as a "Small" size dam by virtue of its estimated total capacity of 50 acre-feet.

d. Hazard Classification. A "High" hazard classification is assigned consistent with the dam's location above an urban area and the potential to cause extensive property damage and loss of life downstream along the creek.

e. Ownership. The dam is owned by the Martins Dam Club. All correspondence should be addressed to Mr. Benjamin Napier, Resident Manager, Post Office Box 186, Wayne, Pennsylvania 19087.

f. Purpose of Dam. The dam was originally built as a water supply dam and was later used for recreation. Since the club installed swimming pools, the dam and its reservoir are no longer used.

g. Design and Construction History. The dam was built sometime before 1886, when ownership was conveyed to the Lower Merion Water Company. Lower Merion Water Company never transacted any business, and by 1919, its assets were controlled by Morgan, Lewis & Bockius, Counselors at Law, Philadelphia. The 1919 State report on small dams described

the dam type as "earth with drywall on downstream side, wall supported by four foot buttresses, 12 feet center to center, top 20 feet wide, carries improved road". The report also noted that the "buttress on the left of the waste pipe was gone, destroyed, buttress on right in poor condition. Twelve inch cast iron waste pipe." In 1919, the State Water Supply Commission requested copies of plans, to which Morgan, Lewis & Bockius replied they did not know of any plans showing the construction of the dam. As a state highway crossed the dam breast, the State Water Supply Commission sought to determine who was responsible for maintenance of the dam. Although several letters passed between the lawyers, the State Water Supply Commission and the State Highway Department, no decision was made on who was responsible for maintenance of the dam. The condition of the dam remained essentially unchanged until 1936, when the dam was sold to the Martins Dam Club, who had been leasing the dam and reservoir for at least three years. In 1937, the State Water Supply Board suggested that the new owners repair the downstream wall. In March 1937, the Owner's engineer considered that there was a possibility of the whole road collapsing at the location of the spillway unless very extensive repairs were made. He seemed to be of the impression that as this is a state road, repairs at that point should be made by the state authorities. An engineer from the State Highway Department inspected the dam and found a few stones in the retaining wall had been dislodged, but did not consider this condition serious. Repairs were made to the stone wall. The Water Supply Board inspected the repair work and found it satisfactory. Sometime after 1941, the 48 inch corrugated metal pipe spillway extension was installed. In 1957 or 1958, swimming pools were built, thereafter the reservoir was no longer used for swimming. About 12 years ago (1967), Upper Merion Township employees placed rock on the downstream slope, reportedly crushing the pond drain outlet. In 1976, the club measured the depth of sediment in the pond and considered dredging the pond. Apparently, this was never done. In 1978 or 1979, the present guardrail was installed. In June 1979, the new sewer line near the left abutment was installed.

In September 1979, the dam was overtopped by Hurricane David, washing away the downstream rock fill, causing the corrugated metal spillway extension to become dislodged and to wash downstream. The guardrails were left unsupported in the center of the dam, and the pavement was undermined on the downstream slope. By January 1980, the corrugated metal extension was replaced and rock placed on the downstream face to support the pavement and guardrail.

h. Normal Operating Procedures. Reservoir flows are normally discharged over the stone weir and through the steel spillway pipe. The valve controlling the 12 inch cast iron

reservoir drain is normally left open about five of 16 turns to keep the pipe running freely.

1.3 Pertinent Data.

A summary of pertinent data for Martins Dam is presented as follows.

a.	Drainage Area (square miles)	0.52
b.	Discharge at Dam Site (cfs)	
	Maximum Known Flood at Dam Site	Unknown
	At Top of Dam	28
c.	Elevation (feet above MSL)	
	Top of Dam	286.3
	Spillway Weir	285.0(1)
	Pond Drain Inlet	Unknown
d.	Reservoir (feet)	
	Length at Normal Pool	550
e.	Estimated Storage (acre-feet)	
	To Spillway	47
	To Top of Dam	50
f.	Reservoir Surface Area (acres)	
	Sediment Pool	4.0 (est)
g.	Dam Data	
	Type	Earth w/ downstream masonry wall & rock fill
	Volume	8,000 cu yds (est.)
	Length	260 feet
	Maximum Height	22.5 feet
	Top Width	21 feet
	Side Slopes	
	Upstream	2H:1V
	Downstream	1.7H:1V & vertical
	Cutoff	Unknown
	Grout Curtain	None
h.	Spillway	
	Type	Stone weir and 36" diameter steel pipe w/ 48" diameter CMP extension

Reservoir Drain	12 in. diameter cast iron pipe
Elevations (feet)	
Weir	285.0
Pond Drain	Unknown
Conduit Outlet Invert	282.1
Energy Dissipator	None

(1) Spillway crest elevation assumed to be 285.0 from USGS Quad Sheet. All other elevations are relative.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Data Available. The only data available for review are the state inspection reports and photographs contained in the Department of Environmental Resources files. These reports contain a limited description of the physical features of the dam. There is no record of any engineering analyses ever being performed for this dam.

b. Design Features. The principal design features of Martins Dam are illustrated on the plans and cross-sections enclosed in Appendix E. Data for these sections were obtained from the field investigation in November and December 1979.

2.2 Construction.

Beyond the limited information given in Section 1.2, there is no data available concerning the construction history of this dam and reservoir.

2.3 Operational Data.

There are no operational records maintained. There are no minimum flow requirements downstream of this dam. However, in order to keep the pond drain pipeline running freely, the valve controlling it is left open about five out of 16 turns. In order to open or close the pond drain valve, the valve box must be pumped out and the valve opened or closed with a monkey wrench.

2.4 Evaluation.

a. Availability. Information presented herein was obtained from records located in the Department of Environmental Resources files in Harrisburg, Pennsylvania, and from conversations with the Owner's representative.

b. Adequacy. The available data included in the state files and presented in this report are not adequate to evaluate the engineering aspects of the dam and appurtenant structures.

c. Validity. There is no reason to question the validity of the limited available data.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. Observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix A, and are summarized and evaluated in the following subsections. In general, the appearance of the facility in November 1979, indicate that the dam was in fair condition. A plan and cross-section of the dam, based on field observations, are shown in Plates 2 and 3, Appendix E.

b. Dam. The vertical alignment of the dam was checked and spot elevations are shown on Plate 2, Appendix E. No discernible horizontal displacement or bulging was noted along the crest, although considerable amount of erosion had taken place as the result of overtopping in September 1979. The most severe erosion occurred at the maximum section around the spillway outlet. A corrugated metal pipe spillway extension was washed away. Rock fill washed away from the downstream face, exposing the interior masonry wall of the dam and leaving the guardrail posts unsupported. There are apparent tension cracks in the roadway pavement at the maximum section, probably resulting from erosion of the downstream slope and undermining of the pavement. Erosion has occurred at both downstream junctions of the abutments and embankment as a result of the overtopping. The amount of erosion at the left junction has increased because of the recent installation of a sewer line. Large trees grow on both the upstream and downstream slopes of the embankment. No seepage was observed; however, the rock at the maximum section could mask any seepage. By January 1980, the CMP spillway extension was replaced, the erosion at the left abutment repaired and covered with a jute mat, and downstream rock fill replaced. The pavement, guardrails and shoulder were restored to a serviceable condition.

c. Appurtenant Structures.

1. Spillway. The stone entrance to the spillway is in fair condition, with some mortar and stone missing from the sidewalls. The 36 inch steel pipe extends horizontally through the embankment. The 48 inch corrugated metal extension was replaced in December, sloping downward. The downstream end is supported by a guardrail section, which has since been covered by rock. Water discharging through the spillway flows directly onto the rock and down to the natural stream.

2. Outlet Works. A valve box is located about seven feet into the reservoir directly opposite the spillway inlet. In order to open or close the valve to the 12 inch cast iron reservoir drain, the valve box must be pumped out and a monkey wrench used on the valve, located at the bottom of the box. The outlet of the drain cannot be located. Reportedly, this had been damaged when the downstream rock was placed 12 years ago. Although the valve is usually left partially open, it can be closed completely.

A second smaller brick valve box near the right abutment is visible when the reservoir is lowered. The outlet of that pipe cannot be located. Reportedly, the valve cannot be seen and a key would be required to operate the valve as the box is too small to enter.

d. Reservoir. The reservoir slopes are moderate to steep and vegetated to the water's edge with grass or trees. A considerable amount of sediment has accumulated within the reservoir and at the upper end. Sediment accumulation probably has some effect on flood water storage. About 600 feet above Martins Dam reservoir are ponds that were formerly the Colonial Village Swimming Club. Although Plate 1 indicates that these are on-stream dams, they are not. Crow Creek flows to the left of both of these ponds.

e. Downstream Channel. Immediately below the dam, the eight foot wide channel flows through a relatively wide wooded floodplain. The stream banks are low and have side slopes ranging from 1H:1V to 5H:1V. The first downstream damage point is a house about 400 feet below the dam, whose first floor is about six feet above the channel bank. There are two more houses nearby at about the same elevation. About one mile below the dam, the creek enters a developed area, including a motel complex and a shopping center, where the creek will be enclosed in a conduit presently under construction. The conduit is designed to pass the 100 year flood with no allowance for upstream dam failures. Flows in excess of 1,050 cfs will be diverted into the lower level of the parking garage for temporary storage. Thus, in the event of failure, excessive property damage is likely and possible loss of life, justifying a "High" hazard classification.

3.2 Evaluation.

In summary, the visual survey of the dam and appurtenant facilities disclosed no evidence of incipient failure of the dam itself. However, at the time of the inspection, the pavement support was undermined to the extent that the roadway was in an unsafe condition. The roadway has since been restored by the Pennsylvania Department of Transportation to a serviceable condition.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures.

Operation of the dam does not require a dam tender. Under normal conditions, the pond drain valve is left partially open, permitting water to discharge through the pond drain. Water also normally discharges through the spillway. The entrance to the spillway is at elevation 285.0.

4.2 Maintenance of the Dam.

Pennsylvania Department of Transportation (PennDOT) claims responsibility for maintenance of the roadway and shoulders only. As far as PennDOT is concerned, the dam need not exist. Based on the visual inspection, it is believed that the only maintenance provided is to the roadway crossing the dam.

4.3 Maintenance of Operating Facilities.

The reservoir level is lowered twice yearly for routine maintenance of the reservoir area and during cleaning of the swimming pools. The reservoir is lowered to reduce the hydrostatic pressure on the swimming pools when they are empty.

4.4 Warning Systems In Effect.

There is no written warning system in effect. The Owner's representative indicated that in the event a problem developed, he would know everyone immediately downstream to warn, about seven households.

4.5 Evaluation.

It is judged that the current operating procedure, which does not require a dam tender, is a realistic means of operating the relatively simple control facilities of Martins Dam. A formal agreement as to the responsibility of PennDOT and Martins Dam Club for maintenance of the roadway, spillway and embankment slopes should be entered into.

In conclusion, it is noted that formal operational, maintenance and warning procedures should be developed and

implemented as soon as practical. It should be noted that these procedures should include an inspection checklist, which would include a listing of items to be checked during each inspection and repaired as necessary to insure proper performance of the structure.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. There is no original design or subsequent evaluation data available for this dam. The watershed is about one mile long and averages about 0.6 mile wide, having a total drainage area of 0.52 square mile. Elevations within the watershed range from about 550 feet in the upper reaches to about 285 feet at the normal pool elevation. The watershed is approximately 75 percent wooded, with 75 percent residential development. Future development is limited because of the steep watershed slopes. About 1,000 feet above Martins Dam are ponds that were formerly the Colonial Village Swimming Club. Although Plate 1 indicates that these are on-stream dams, they are not. Crow Creek flows to the left of both of these ponds.

In accordance with criteria established by Federal (OCE) Guidelines, the selected spillway design flood for this "Small" size dam and "High" hazard classification is one-half the Probable Maximum Flood (PMF).

b. Experience Data. There are no records of reservoir levels or rainfall kept for this dam. There are no estimates or records of previous high water levels. It is reported that this dam has been known to be overtopped three times since 1928. The visual inspection disclosed that the dam had also been overtopped in September 1979, as a result of Hurricane David.

c. Visual Observations. On the date of the inspection, the only condition observed that might indicate a possible reduction in spillway capacity is that the spillway itself is very small, with no trash rack, and it is considered likely that debris would clog the spillway entrance during a large storm. Observations regarding the condition of the downstream channel, spillway and reservoir are located in Appendix A and are discussed in greater detail in Section 3, and recommendations are made in Section 7.

d. Overtopping Potential. The overtopping potential of this dam was estimated using the HEC-1, Dam Safety Version, computer program. A brief description of the program is included in Appendix D. A detailed inspection of the two upstream dams could not be made. Visual inspection through the fence surrounding these dams indicated that although they are bypass ponds, flows from storms approaching the 100 year frequency will flow through the ponds. They have no emergency

spillways, but do have masonry tops. For lack of information, these ponds have been neglected in the analysis of the downstream Martins Dam, although it is estimated that failure of these ponds during an extreme event would not significantly increase the peak inflow to Martins Dam reservoir.

Calculations for this investigation estimate a spillway discharge of only about 28 cfs with the reservoir level at the minimum top of the embankment. The HEC-1 program computed the peak PMF inflow to be about 1,900 cfs. The computer program indicates that even 0.1 PMF, or 189 cfs inflow, from about 2.5 inches of rain in 24 hours overtops the dam. These results are consistent with Hurricane David, during which about 3.7 inches of rain fell in 24 hours.

e. Spillway Adequacy. A spillway that will not pass 0.5 PMF without overtopping the dam is rated as "Seriously Inadequate", provided two other conditions are present. One is failure of the dam by overtopping. The dam is assumed capable of withstanding overtopping of up to two feet before failing as a result of overtopping. As estimated by the HEC-1 computer program, the dam will fail at events approaching 0.4 PMF. The second requirement for a "Seriously Inadequate" spillway is that the downstream damage resulting from failure is significantly greater than that which would occur from high flows just before failure. The visual inspection disclosed that the first floor of the first downstream house is about six feet above the channel. Although the computer program indicates this house would be about one foot above the water level at failure during the PMF, it is possible the house would be affected. It is assessed that although the increase in the peak discharge from failure over nonfailure is not significantly large, the increased quantity of water downstream in the shopping center will be significant and will cause a significant increase in damage at the downstream mall, as noted in paragraph f. Therefore, the spillway is rated as "Seriously Inadequate".

f. Downstream Conditions. It is assessed that the major downstream hazard center is located approximately one mile below the dam, principally at the King of Prussia Mall. The existing shopping mall is being expanded and, as part of this expansion, Crow Creek is being enclosed in a twin culvert. The design of the culvert and the storm water management plan are based on limiting the outflow from the mall site to the present one hundred year peak runoff of 1,360 cfs. There is a diversion chamber in the conduit which will direct flows in excess of 1,050 cfs to enter the main parking structure. Such diversion will occur for storms greater than about a 25 year frequency. The lower level of the main parking structure is about 10 acres, and about seven are designed to be flooded. Additional flood water resulting from

a dam failure will increase the area of flooding. As the outflow from the main parking structure is limited, the depth of water would increase rapidly within the parking structure, increasing the potential for damage. Although a detailed warning system is being developed by the designers to be implemented by mall personnel, it is conceivable that Martins Dam failure could significantly increase damage and possible loss of life.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. The only evidence of existing or pending embankment or spillway instability detected by visual observations would be that which would result from overtopping. The upstream slope of the embankment appeared to be stable. The downstream slope had been largely washed away by overtopping in September 1979. Although the slope has been repaired, overtopping could again result in the same condition.

b. Design and Construction Data. Design drawings and stability analysis do not exist for this structure. Based on the dam's longevity and lack of visual signs of significant deterioration, it is qualitatively assessed that the stability of the dam is adequate. However if the dam is overtopped for a significant period of time, judged to occur when the depth of overtopping is on the order of two feet or more, it is believed likely that the dam would fail by erosion of the downstream rubble wall.

c. Operating Records. There are no operational records for this structure.

d. Post-Construction Changes. The major post-construction change was the addition of the rock fill downstream of the masonry wall. The purpose of this fill was to support the state roadway across the breast of the dam. However, the fill also serves to protect the downstream wall in the event of overtopping.

e. Seismic Stability. The dam is located in Seismic Zone 1. Normally it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake conditions. As the dam is qualitatively assessed to be stable under static loading conditions, it can reasonably be assumed to be stable under seismic loading conditions.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Evaluation. Visual inspection indicates that the dam, foundation and spillway structures of Martins Dam are in fair condition. The hydrologic and hydraulic computations presented in Appendix D indicate that the structure will not pass 0.1 PMF (Probable Maximum Flood) without overtopping. It is assessed that 0.5 PMF would cause failure and significantly increase the potential for excessive property damage and loss of life in the major downstream damage center, King of Prussia Mall. Therefore, the spillway system of this "High" hazard classification structure is considered to be "Seriously Inadequate", and the dam is in an "unsafe nonemergency" condition.

b. Adequacy of Information. The combined visual inspection, obvious performance history of this structure, and simplified calculations presented in Appendix D were sufficient to determine that a further detailed hydrologic and hydraulic analysis is required.

c. Urgency. It is recommended that the measures presented in Section 7.2 be implemented as specified.

7.2 Remedial Measures.

a. Facilities. It is recommended that the following measures be taken immediately. All work should be done under the supervision of a registered professional engineer experienced in the design of dams.

1. A detailed hydrologic/hydraulic study should be made to determine the best method of increasing the spillway capacity to meet current hydrologic/hydraulic criteria.

2. The large trees on both the upstream and downstream slopes of the embankment should be removed. However, the long-term stability of the slopes should be evaluated in light of decaying root systems.

3. Consideration should be given to improving access to the pond drain valve and to making operational the second reservoir drain, shown in the 1939 photograph (Photograph No. 14, Appendix C).

b. Operation and Maintenance Procedures. Because of the location of the dam and the potential for heavy property damage and possible loss of life in the event of failure, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning downstream residents and particularly the King of Prussia Mall that high flows are expected and provisions for evacuating these people in the event of an emergency. In addition, a formal agreement between Martins Dam Club and the Pennsylvania Department of Transportation should be made delineating maintenance responsibility. An operation and maintenance procedure should also be developed to insure that all pertinent items are carefully inspected on a regular basis and maintained in the best possible condition.

APPENDIX

A

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam *Martins Dam* County *Montgomery* State *Pennsylvania* National ID # *PA 00620*

Type of Dam *Masonry & Earth* Hazard Category *High*

Date(s) Inspection *11/12/79* Weather *Cloudy* Temperature *50's*

Pool Elevation at Time of Inspection *285.2±* M.S.L. Tailwater at Time of Inspection *N/A* M.S.L.

Inspection Personnel:

Mary F. Beck (Hydrologist)
Raymond S. Lambert (Geologist)
Arthur H. Dvinoff (Geotechnical/Civil)
John Fredericks (Geotechnical/Civil) (10/31/79)
Vincent McKeever (Hydrologist)

Mary F. Beck Recorder

Remarks:

Mr. Benjamin Napier, representing Martins Dam Club, was on site and provided information to the inspection team.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

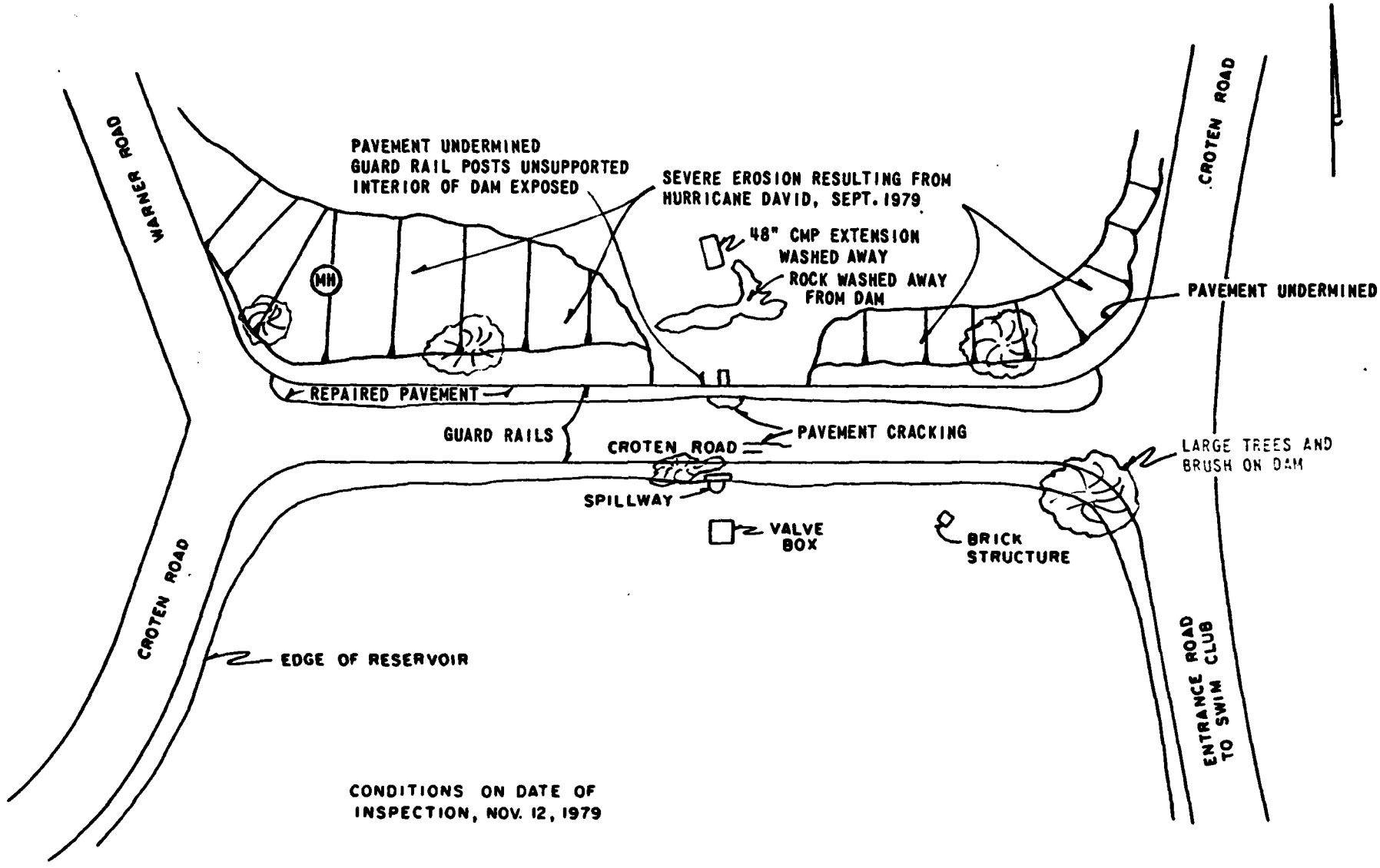
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	*Apparent tension cracks in roadway pavement at maximum section, possibly resulting from erosion of downstream slope, see Photographs, Appendix D.*	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	*None observed.*	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	*Considerable erosion of downstream slope as a result of Hurricane David, September 5-6, 1979.*	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	*See Plate 2, Appendix E.*	
RIPRAP FAILURES	*N/A*	

EMBANKMENT

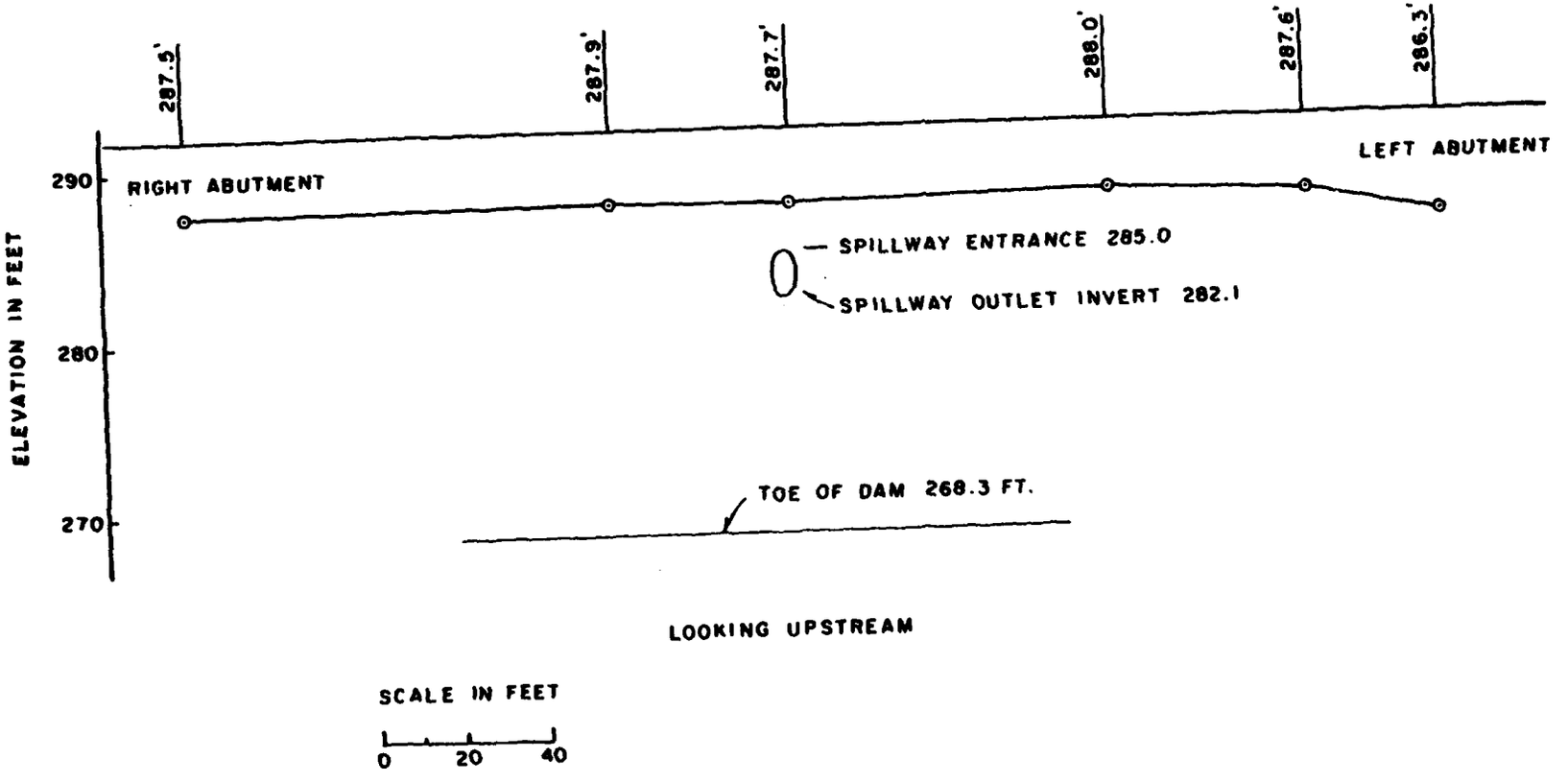
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	*Erosion at both downstream juctions of abutments and embankment as a result of overtopping. Amount of erosion at left junction increased because of recent sewer line installation. Erosion at left abutment repaired by December 1979.*	
ANY NOTICEABLE SEEPAGE	*None observed, however rock at maximum section could mask seepage.*	
STAFF GAGE AND RECORDER	*None.*	
DRAINS	*None observed.*	



CONDITIONS ON DATE OF
INSPECTION, NOV. 12, 1979

FIELD OBSERVATION PLAN
MARTINS DAM

SHEET 5A OF 11



FIELD OBSERVATION PROFILE
MARTINS DAM

SHEET 5B OF 11

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	*N/A, outlet conduit is steel.*	
INTAKE STRUCTURE	*In fair condition, constructed of masonry. Some wing wall stone is missing.*	
OUTLET STRUCTURE	*In poor condition, prior to September 1979, the outlet conduit was extended by CMP. Water discharged onto stone at downstream toe. Hurricane David (September 1979) dislodged the CMP, see Photograph No. 5. Extension subsequently replaced in December 1979.*	
OUTLET CHANNEL	*None, the spillway conduit discharges onto rock and water enters directly to the stream.*	
EMERGENCY GATE	*The reservoir drain is reportedly damaged but functional.*	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	*N/A*	
APPROACH CHANNEL	*N/A*	
DISCHARGE CHANNEL	*N/A*	
BRIDGE AND PIERS	*N/A*	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	*N/A*	
APPROACH CHANNEL	*N/A*	
DISCHARGE CHANNEL	*N/A*	
BRIDGE AND PIERS	*N/A*	
GATES AND OPERATION EQUIPMENT	*N/A*	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	*None*	
OBSERVATION WELLS	*None*	
WEIRS	*None*	
PIEZOMETERS	*None*	
OTHER	*None*	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	*The reservoir slopes are moderate to steep and vegetated to water's edge with grass or trees. Small amount of branches enter the reservoir, the spillway inlet is small and can easily be at least partially blocked.*	
SEDIMENTATION	*A considerable amount of sediment has accumulated within the reservoir and at the upper end. Sediment accumulation has slight effect on flood water storage.*	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	*An eight foot wide channel flows through a wooded flood plain. The stream banks are low and have slopes ranging from 1H:1V to 5H:1V.*	
SLOPES	*The valley gradient is about 0.02.*	
APPROXIMATE NO. OF HOMES AND POPULATION	*The first damage point is a house about 400 feet below the dam whose first floor is about six feet above the channel bank. There are two more houses at about the same elevation. About one mile below the dam, the creek enters a developed area including a motel complex and a shopping center where the creek will be enclosed in a conduit presently under construction.*	

APPENDIX

B

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM *Martins Dam*

ID # *PA 00620*

ITEM	REMARKS
AS-BUILT DRAWINGS	*See Appendix E.*
REGIONAL VICINITY MAP	*See Appendix E.*
CONSTRUCTION HISTORY	*See Section 1.2, paragraph g.*
TYPICAL SECTIONS OF DAM	*See Appendix E.*
OUTLETS - PLAN	*See Appendix E.*
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	*See Appendix D.*
RAINFALL/RESERVOIR RECORDS	*None.*

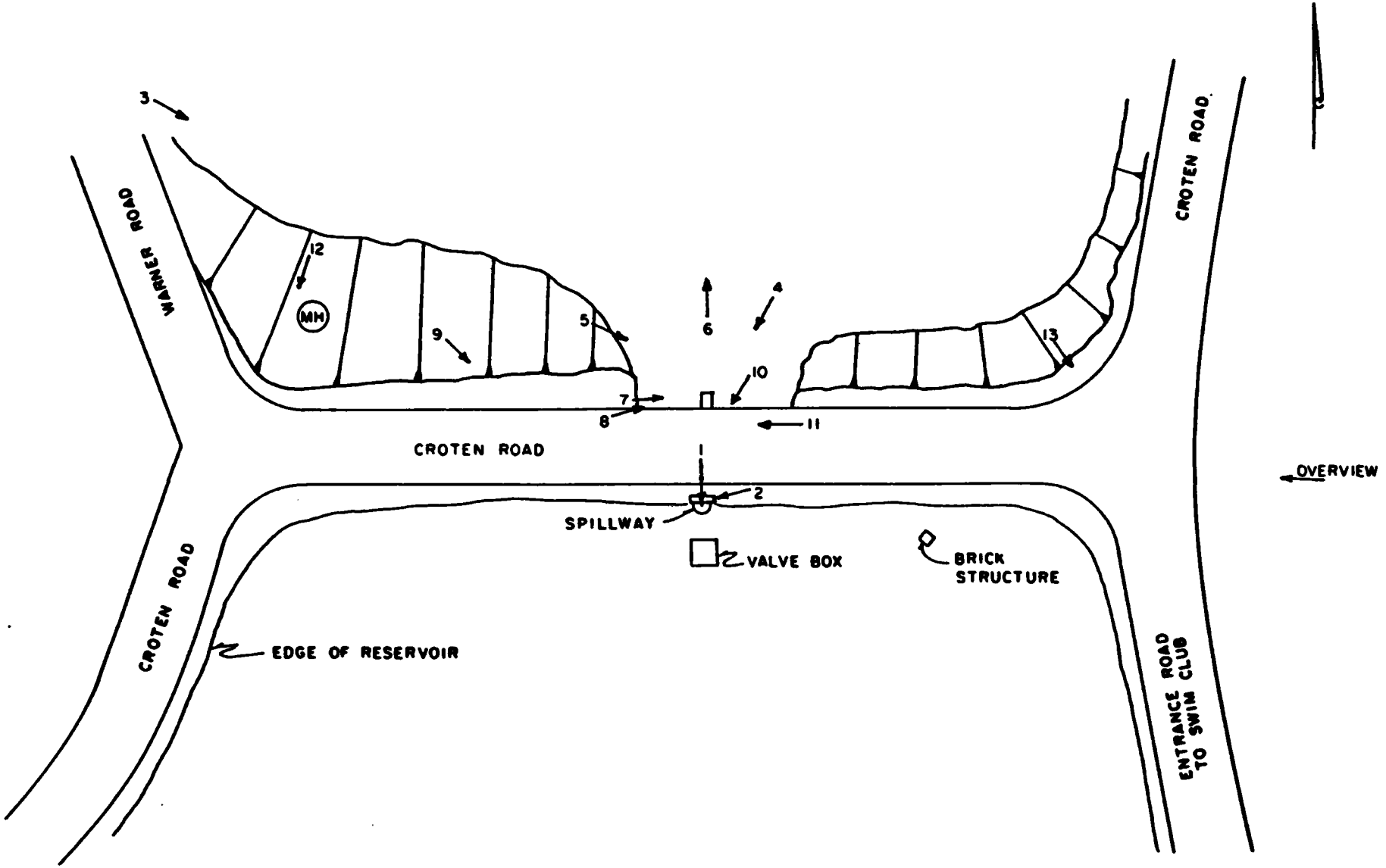
ITEM	REMARKS
DESIGN REPORTS	*None.*
GEOLOGY REPORTS	*See Appendix F.*
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	*No original computations or previous evaluations available.*
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	*None.*
POST-CONSTRUCTION SURVEYS OF DAM	*None known.*
BORROW SOURCES	*Unknown.*

ITEM	REMARKS
MONITORING SYSTEMS	*None.*
MODIFICATIONS	*See text.*
HIGH POOL RECORDS	*None.*
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	*None known.*
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	*Overtopping, see text.*
MAINTENANCE OPERATION RECORDS	*None.*

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	*None. A field sketch was prepared and is presented in Appendix E.*
OPERATING EQUIPMENT PLANS & DETAILS	*None.*
MISCELLANEOUS	1. *Inspection reports in DER files.* 2. *Eight black and white photographs.* 3. *Miscellaneous correspondence and memos in DER files.*

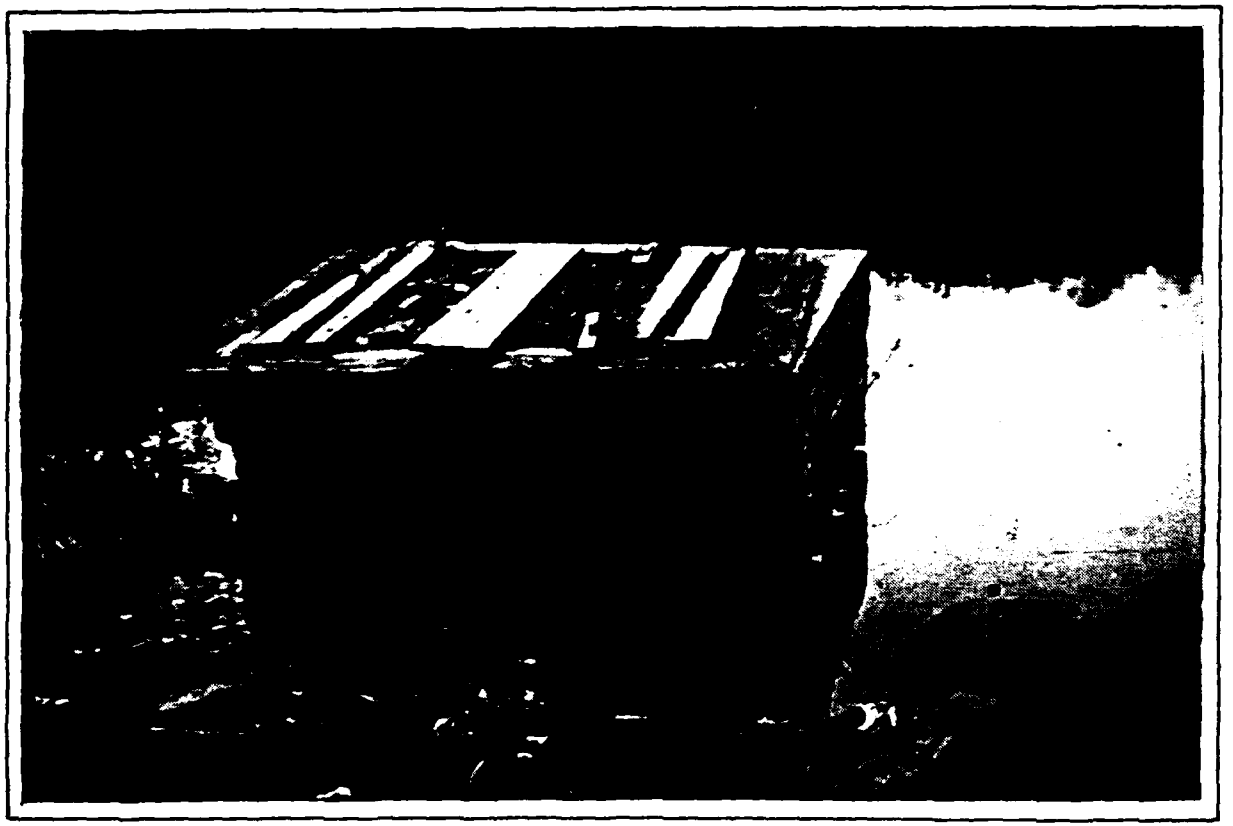
APPENDIX

C



PHOTOGRAPH LOCATION PLAN
MARTINS DAM

PLATE C-1



VALVE BOX FOR RESERVOIR DRAIN.

PHOTOGRAPH NO. 1

THE SPILLWAY INLET.

PHOTOGRAPH NO. 2

VIEW OF UPSTREAM SIDE OF DAM.

PHOTOGRAPH NO. 3

SPILLWAY OUTLET.

PHOTOGRAPH NO. 4

OVERALL VIEW OF DOWNSTREAM SLOPE.
NOTE DISLODGED SPILLWAY EXTENSION
CONDUIT AND LARGE TREES.

PHOTOGRAPH NO. 5

VIEW OF CHANNEL BELOW DAM.

PHOTOGRAPH NO. 6

INTERIOR OF DAM. NOTE UNSUPPORTED GUARDRAIL POSTS.

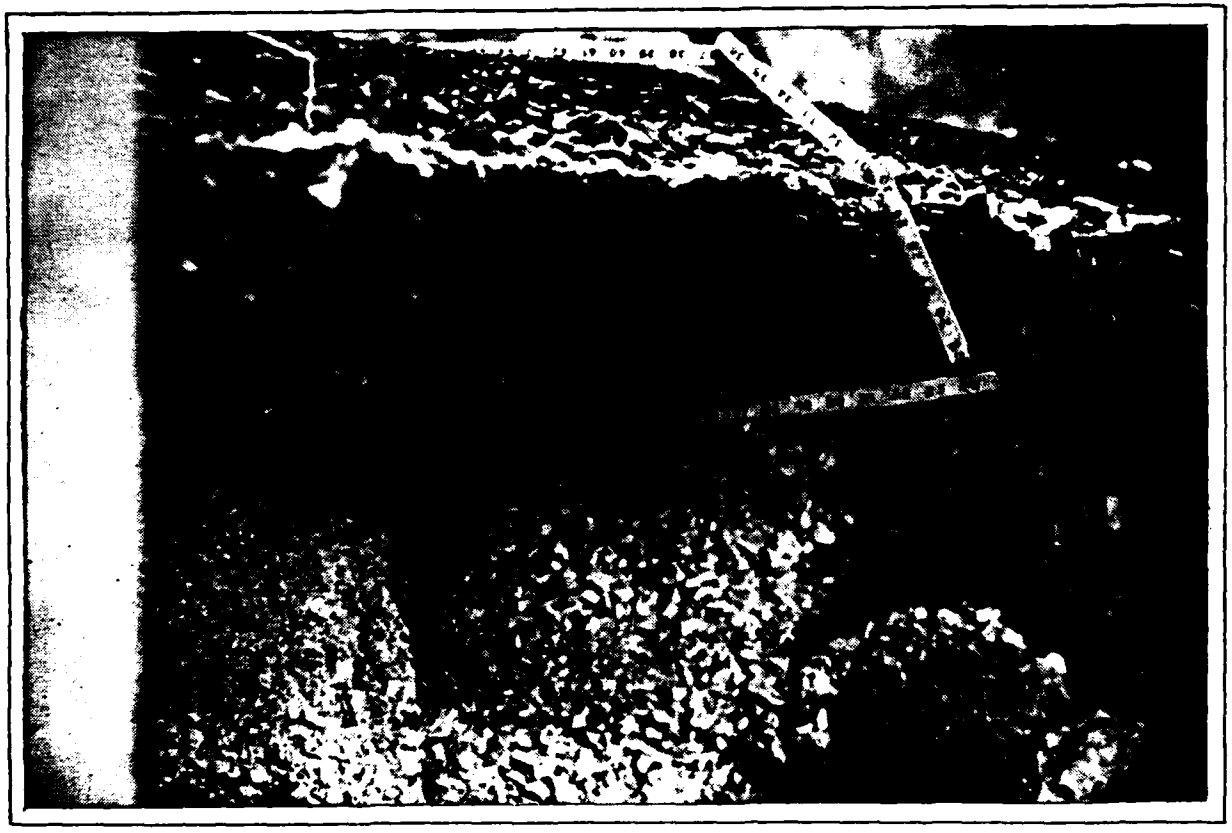
PHOTOGRAPH NO. 7

UNSUPPORTED GUARDRAIL POSTS.

PHOTOGRAPH NO. 8

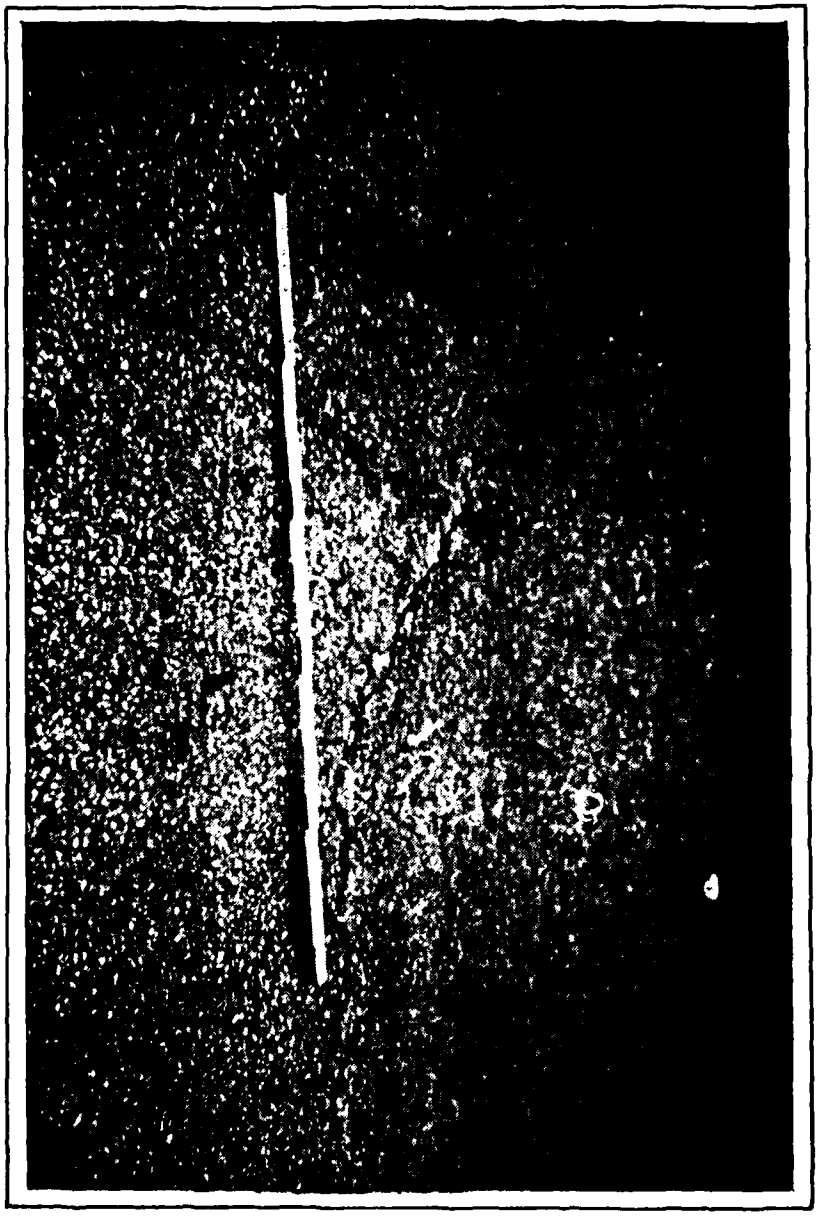
VIEW OF DOWNSTRAM BANK SHOWING
EROSION AND TREES.

PHOTOGRAPH NO. 9



VIEW SHOWING DEPTH TO WHICH PAVEMENT
IS UNDERMINED.

PHOTOGRAPH NO. 10



TENSION CRACKS IN PAVEMENT
NEAR PATCH ON DOWNSTREAM
SIDE.

PHOTOGRAPH NO. 11

EROSION AT LEFT END OF EMBANKMENT.
PICUTRE TAKEN SEPTEMBER 1979.

PHOTOGRAPH NO. 12

EROSION AT RIGHT END OF EMBANKMENT.

PHOTOGRAPH NO. 13

PHOTOGRAPH TAKEN IN 1939 BY WATER SUPPLY COMMISSION INSPECTOR. NOTE SPILLWAY, RESERVOIR DRAIN BELOW SPILLWAY, AND A SECOND OUTLET PIPE BEHIND TREE BRANCHES NEAR LEFT SIDE OF PICTURE.

PHOTOGRAPH NO. 14

APPENDIX

D

MARTINS DAM

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: *75% wooded and 75% residential development.*

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): *285.0 feet.*

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): *286.3 feet (est. 50 Acre-feet)*

ELEVATION MAXIMUM DESIGN POOL: *286.3 feet.*

ELEVATION TOP DAM: *286.3 feet.*

SPILLWAY

a. Elevation *285.0 feet (from USGS map)*

b. Type *Drop inlet and 36 inch steel pipe.*

c. Width *Inlet weir about 6 feet long.*

d. Length *About 45 feet.*

e. Location Spillover *At maximum section.*

f. Number and Type of Gates *None*

OUTLET WORKS:

a. Type *N/A*

b. Location *N/A*

c. Entrance inverts *N/A*

d. Exit inverts *N/A*

e. Emergency draindown facilities *12 inch CIP near base of dam.*

HYDROMETEOROLOGICAL GAGES:

a. Type *None*

b. Location *N/A*

c. Records *N/A*

MAXIMUM NON-DAMAGING DISCHARGE: *Not determined*

DRAINAGE AREA:(1) *0.52 square mile.*

PROBABLE MAXIMUM PRECIPITATION (PMP)
FOR 10 SQ. MILES IN 24 HOURS:(2) *23.5 inches.*

ADJUSTMENT FACTORS FOR DRAINAGE AREA (%):(3)

Zone *6*

6 Hours *113*

12 Hours *123*

24 Hours *132*

48 Hours *142*

SNYDER HYDROGRAPH PARAMETERS:(4)

Zone *7*

C_p, C_t *0.65, 1.35*

L(5) *1.09 miles*

Lca (6) *0.57 mile*

$tp=C_t\ (L \cdot Lca)^{0.3}$ *1.17*

SPILLWAY CAPACITY AT MAXIMUM
WATER LEVEL(7) *28 cfs*

---

(1) Measured from USGS maps.
(2) Hydrometerological Report No. 33, Figure 1.
(3) Hydrometerological Report No. 33, Figure 2.
(4) Information received from Corps of Engineers, Baltimore District.
(5) Length of longest water course from outlet to basin divide, measured from USGS maps.
(6) Length of water course from outlet to point opposite the centroid of drainage area, (see Plate 1, Appendix E) measured from USGS maps.
(7) See Sheet 12 of this Appendix.

HEC-1, REVISED
FLOOD HYDROGRAPH PACKAGE

The original "Flood Hydrograph Package" (HEC-1), developed by the Hydrologic Engineering Center, Corps of Engineers, has been modified for use under the National Dam Inspection Program. The "Flood Hydrograph Package (HEC-1), Dam Safety Version", hereinafter referred to as, HEC-1, Rev., has been modified to require less detailed input and to include a dam breach analysis. The required input is obtained from the field inspection of a dam, any available design/evaluation data, relatively simple hydraulic calculations, or information from the USGS Quandrangle maps. The input format is flexible in order to reflect any unique characteristics of an individual dam.

HEC-1, Rev. computes a reservoir inflow hydrograph based on individual watershed characteristics such as: area, percentage of impervious surface area, watershed shape, and hydrograph characteristics determined from regional correlation studies by the Corps of Engineers, Baltimore District. The inflow is routed through the reservoir using spillway discharge data obtained from the field inspection or design data. Flood storage capacity is determined from USGS maps or design information and verified by the field inspection. In the event a spillway cannot discharge 0.5 PMF without overtopping and failure of the dam, downstream channel characteristics obtained from the field inspection and USGS maps are inputed and flows are routed downstream to the damage center and a dam breach analysis is performed.

Included in this Appendix are the HEC-1, Rev. pertinent input values and a summary print-out tables.

BY MEB DATE 1/14/80 SUBJECT Martins Dam SHEET 4 OF 13

CHKD. BY AHD DATE 1/17/80 Hydrology / Hydraulics JOB No.

Classification (Ref. Recommended Guidelines for Safety Inspection of Dams)

1. The hazard classification is rated as "High" as there would be excessive economic loss and loss of life in the event of failure.

2. The size classification is "Small" based on its estimated total capacity of 50 Ac-Ft.

3. The selected spillway design flood, based on size and hazard classification, is 0.5 PMF (Probable Maximum Flood).

Hydrology and Hydraulic Analysis

1. Original Data. No original design data or subsequent evaluation data exists.

2. Evaluation Data

Inflow hydrograph parameters are shown on sheet 2.

Elevation - storage data for flood water storage was calculated by the computer program based on an estimated total capacity of 50 Ac-Ft. See sheet 8

Elevation-discharge data.

When entrance weir controls flow through spillway

$Q = CLH^{3/2}$

$C = 3.1$ assumed

$L = 6$ ft. field checked

$Q = 18.6H^{3/2}$ ✓

When 96" ϕ steel pipe controls flow through spillway

$Q_p = A_p\sqrt{\frac{2gH}{1+K_e+L_p \cdot K_p}}$ ref. Soil Conservation Service Design Note 8

$A_p = 7.06$ sq. ft

$K_e \sim 0.6$ (design note 8)

$L_p \sim 31$ ft (field checked)

$K_p = 0.00963$ (SCS National Engineering Handbook: Section 5)

H measured to centerline of outlet (283.6)

$Q_p = 41.12H^{1/2}$ ✓

see sheet 8

BY MEB DATE 1/14/80 SUBJECT SHEET 5 OF 13

CHKD. BY AHD DATE 1/17/80 Martins Dam JOB No

Hydrology / Hydraulics

3. Spillway Adequacy

As the spillway will not pass 0.5 PMF without overtopping the dam, the spillway is considered "Inadequate". A spillway is considered "Seriously Inadequate" if two addional criteria is met. One, if overtopping is likely to cause failure. Assumed failure criteria is entered into the program, as shown on sheet 13. It is estimated that 0.4 PMF will cause failure. Second, will failure cause a significant increase in damage at the downstream damage center. Although failure during the PMF increases peak discharge about 8%, failure at 0.4 PMF increases peak discharge about 50%. The main damage center is about one mile downstream, King of Prussia Mall, where Crow Creek is enclosed. The volume of water rather than peak flow rate will influence the amount of damage, see text, Section 5.

4. Hurricane David, Sept. 6, 1979

24 hr. rainfalls for three surrounding weather stations are 3.8, 3.22 and 3.63 inches, overtopping of dam occured.

Rainfall computed by HEC-1 for 0.1 PMF is, 23.5 x 1.32 x 0.8 x 0.1 = 2.48 inches and overtopping is indicated.

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	IN
ROUTE HYDROGRAPH TO	OUT
RUNOFF HYDROGRAPH AT	DS1
RUNOFF HYDROGRAPH AT	DS2
END OF NETWORK	

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 80/01/15.
TIME= 05.29.11.

MARTINS DAM
NAT ID NO. PA 00620 DER ID NO. 46-145
OVERTOPPING ANALYSIS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
200	0	15	0	0	0	0	0	-4	0
			JOPER	NUT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 4 LRTIO= 1
RTIOS= .10 .40 .50 1.00

SHEET 6 OF 13

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
IN	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.52	0.00	.52	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.50	113.00	123.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.17 CP= .65 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 24 END-OF-PERIOD ORDINATES, LAG= 1.17 HOURS, CP= .66 VOL= 1.00

17.	60.	116.	164.	186.	174.	140.	109.	84.	65.
51.	39.	31.	24.	18.	14.	11.	9.	7.	5.
4.	3.	2.	2.						

END-OF-PERIOD FLOW

0 MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.70	24.30	2.40	32646.
										(678.)	(617.)	(61.)	(924.43)

SHEET 7 OF 13

HYDROGRAPH ROUTING

OUTFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUT	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-285.	-1

STAGE	285.00	285.50	286.00	286.50	287.00	288.00	291.00
FLOW	0.00	7.00	19.00	34.00	53.00	80.00 (86)	104.00 (114)

CAPACITY=	0.	50.	65.
ELEVATION=	265.	286.	290.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
285.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
286.3	0.0	0.0	0.

CREST LENGTH	0.	45.	75.	95.	284.	325.	370.
AT OR BELOW ELEVATION	286.3	287.5	287.6	287.7	287.9	288.0	295.0

SHEET 8 OF 13

HYDROGRAPH ROUTING

SECTION 60 FEET BELOW DAM

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0650	.0400	.0650	250.0	265.0	60.	.01300

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 265.00 46.00 253.70 91.00 251.90 146.00 250.50 176.00 250.00
206.00 250.50 242.00 256.10 300.00 265.00

STORAGE	0.00	.05	.15	.28	.45	.64	.84	1.05	1.28	1.51
	1.75	2.00	2.25	2.52	2.80	3.08	3.38	3.68	3.99	4.31
OUTFLOW	0.00	88.32	442.75	1171.70	2288.75	3758.44	5582.57	7726.45	10178.67	12932.13
	15983.08	19328.94	22968.31	26900.68	31126.19	35645.50	40459.66	45570.03	50978.23	56686.12
STAGE	250.00	250.79	251.58	252.37	253.16	253.95	254.74	255.53	256.32	257.11
	257.89	258.68	259.47	260.26	261.05	261.84	262.63	263.42	264.21	265.00
FLOW	0.00	88.32	442.75	1171.70	2288.75	3758.44	5582.57	7726.45	10178.67	12932.13
	15983.08	19328.94	22968.31	26900.68	31126.19	35645.50	40459.66	45570.03	50978.23	56686.12

SHEET 9 OF 13

HYDROGRAPH ROUTING

SECTION 405 FEET BELOW DAM

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0650	.0400	.0650	246.0	258.0	345.	.01300

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 258.10 75.00 252.50 275.00 246.90 278.00 246.00 286.00 246.00
290.00 246.90 316.00 252.50 344.00 258.50

STORAGE	0.00	.05	.15	.36	.70	1.16	1.76	2.48	3.33	4.31
	5.41	6.63	7.90	9.23	10.62	12.07	13.57	15.13	16.75	18.42
OUTFLOW	0.00	17.79	70.97	183.11	376.99	673.12	1089.80	1643.92	2351.34	3227.10
	4285.58	5633.77	7211.79	8979.07	10936.22	13084.56	15425.93	17962.55	20696.93	23631.77
STAGE	246.00	246.63	247.26	247.89	248.53	249.16	249.79	250.42	251.05	251.68
	252.32	252.95	253.58	254.21	254.84	255.47	256.11	256.74	257.37	258.00
FLOW	0.00	17.79	70.97	183.11	376.99	673.12	1089.80	1643.92	2351.34	3227.10
	4285.58	5633.77	7211.79	8979.07	10936.22	13084.56	15425.93	17962.55	20696.93	23631.77

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .40	RATIO 3 .50	RATIO 4 1.00
HYDROGRAPH AT	IN	.52	1	189.	755.	944.	1887.
	(	1.35)	(	5.34)(	21.37)(	26.72)(	53.44)(
			2	189.	755.	944.	1887.
			(	5.34)(	21.37)(	26.72)(	53.44)(
ROUTED TO	OUT	.52	1	184.	752.	941.	1884.
	(	1.35)	(	5.21)(	21.30)(	26.64)(	53.34)(
			2	184.	1091.	1240.	2031.
			(	5.21)(	30.90)(	35.10)(	57.52)(
ROUTED TO	DS1	.52	1	184.	752.	941.	1883.
	(	1.35)	(	5.21)(	21.30)(	26.64)(	53.33)(
			2	184.	1085.	1245.	2036.
			(	5.21)(	30.73)(	35.25)(	57.64)(
ROUTED TO	DS2	.52	1	184.	751.	939.	1881.
	(	1.35)	(	5.21)(	21.26)(	26.58)(	53.26)(
			2	184.	1078.	1270.	2026.
			(	5.21)(	30.52)(	35.96)(	57.38)(

SHEET 11 OF 13

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 No Failure

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	285.00	285.00	286.30
STORAGE	47.	47.	50.
OUTFLOW	0.	0.	28.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	287.72	1.42	56.	184.	7.50	41.00	0.00
.40	288.39	2.09	58.	752.	14.50	40.75	0.00
.50	288.53	2.23	59.	941.	17.25	40.75	0.00
1.00	289.11	2.81	61.	1884.	22.50	40.75	0.00

PLAN 1 STATION DS1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	184.	251.0	41.00
.40	752.	251.9	40.75
.50	941.	252.1	40.75
1.00	1883.	252.9	40.75

PLAN 1 STATION DS2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	184.	247.9	41.00
.40	751.	249.3	40.75
.50	939.	249.6	40.75
1.00	1881.	250.6	40.75

SHEET 12 OF 13

DAM BREACH DATA

BRUID	Z	ELBM	TFAIL	WSEL	FAILEL
50.	0.00	266.00	2.00	285.00	288.30

PLAN 2 .Failure.....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	285.00	285.00	286.30
STORAGE	47.	47.	50.
OUTFLOW	0.	0.	28.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	287.72	1.42	56.	184.	7.50	41.00	0.00
.40	288.35	2.05	58.	1176.	7.62	40.88	40.50
.50	288.40	2.10	58.	1332.	9.38	40.67	40.25
1.00	288.33	2.03	58.	2031.	11.38	40.50	38.50

PLAN 2 STATION DS1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	184.	251.0	41.00
.40	1085.	252.3	40.75
.50	1245.	252.4	40.75
1.00	2036.	253.0	40.50

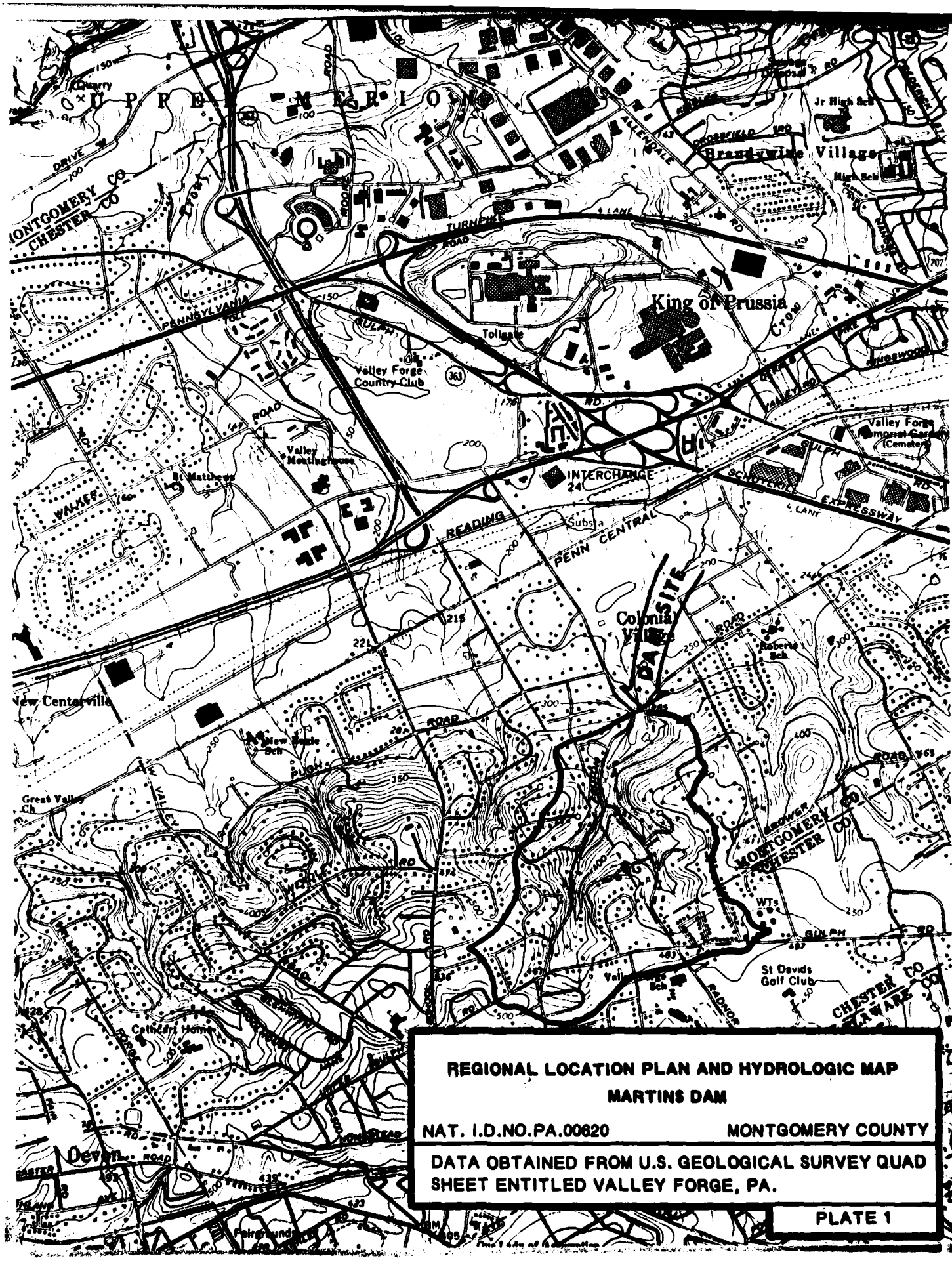
PLAN 2 STATION DS2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	184.	247.9	41.00
.40	1078.	249.8	41.00
.50	1270.	250.0	40.75
1.00	2026.	250.8	40.50

SHEET 13 OF 13

APPENDIX

E

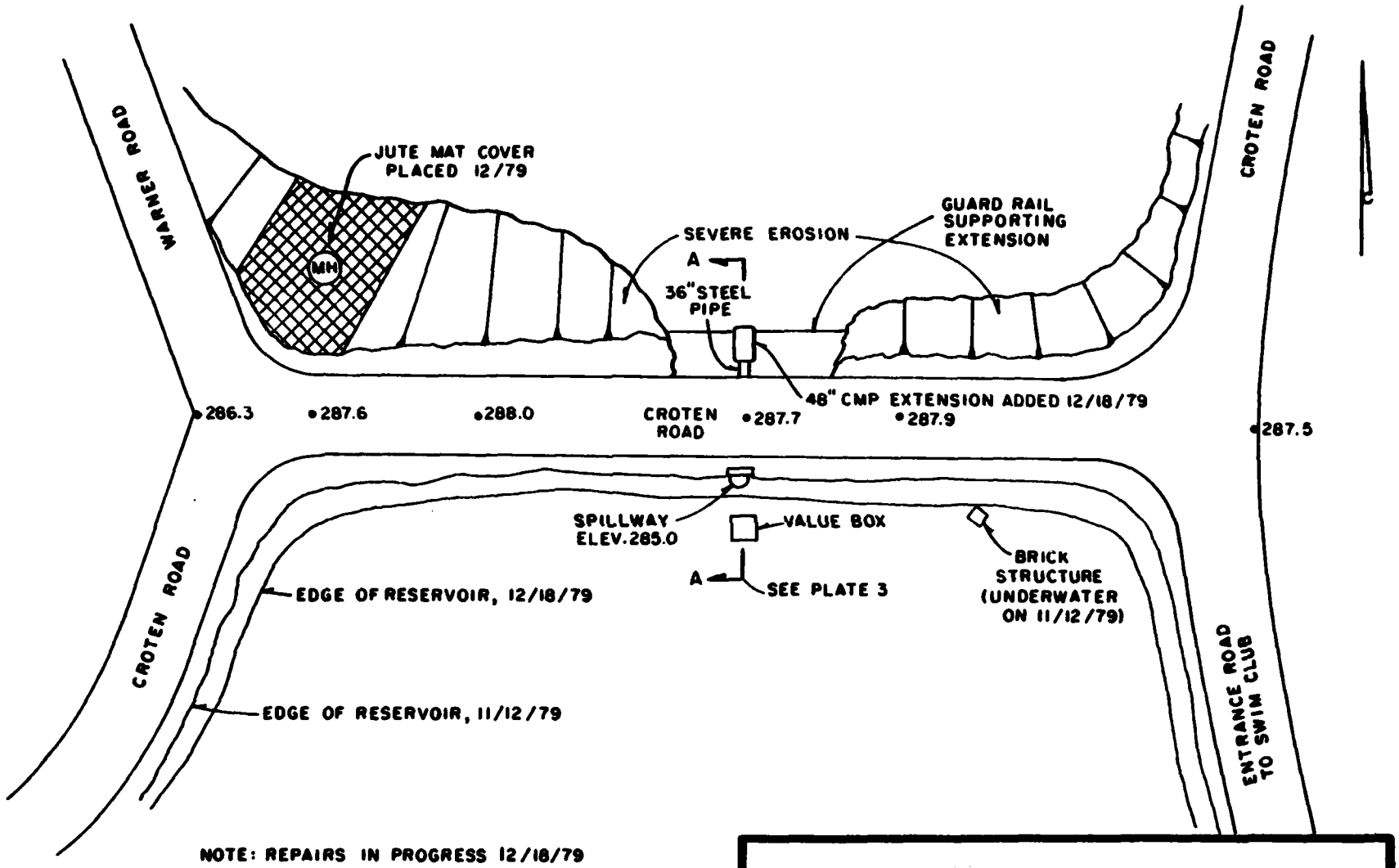


REGIONAL LOCATION PLAN AND HYDROLOGIC MAP
MARTINS DAM

NAT. I.D.NO.PA.00620 **MONTGOMERY COUNTY**

DATA OBTAINED FROM U.S. GEOLOGICAL SURVEY QUAD SHEET ENTITLED VALLEY FORGE, PA.

PLATE 1



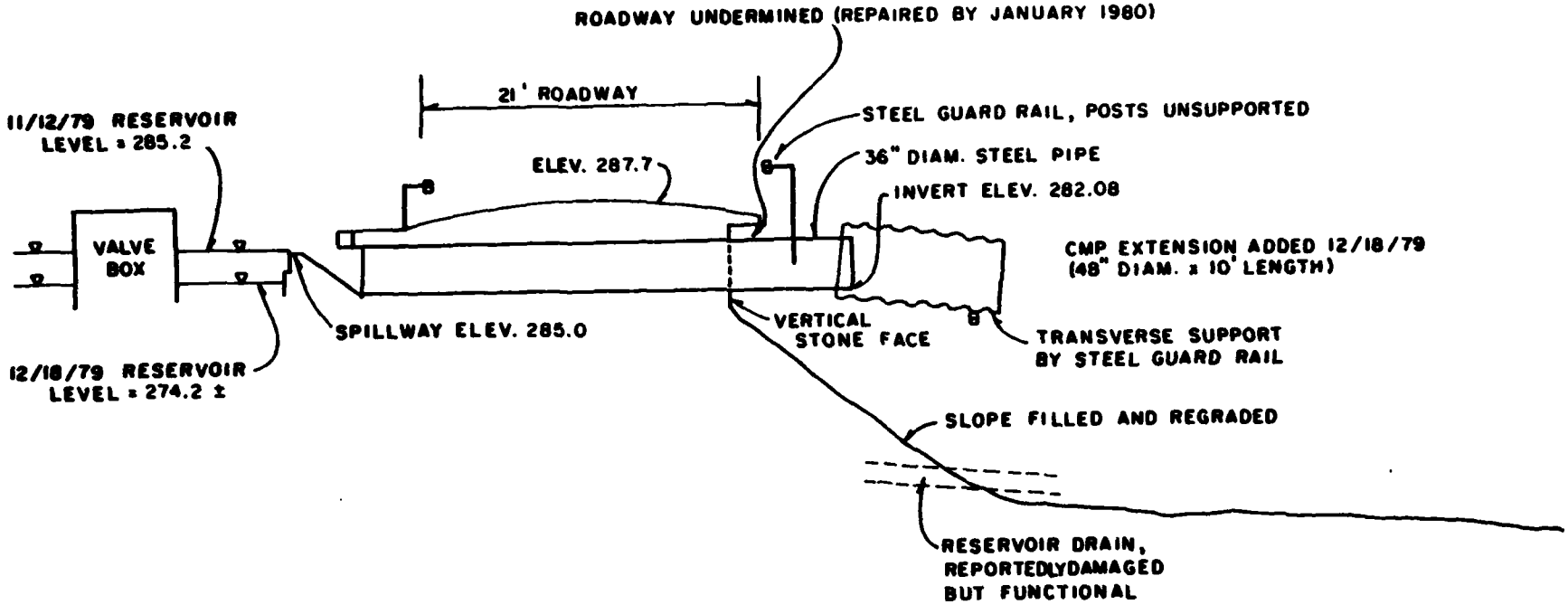
PLAN OF DAM AND APPURTENANCES

MARTINS DAM

NAT. I D NO.PA.00620 MONTGOMERY COUNTY

DATA OBTAINED FROM FIELD INVESTIGATION ON 11/12/79

PLATE 2



NOTE: REPAIRS IN PROGRESS 12/18/79

SCALE IN FEET

0 5 10

EMBANKMENT SECTION A-A

MARTINS DAM

NAT. I.D. NO.PA.00620 MONTGOMERY COUNTY

DATA OBTAINED FROM FIELD INVESTIGATION ON 11/12/79

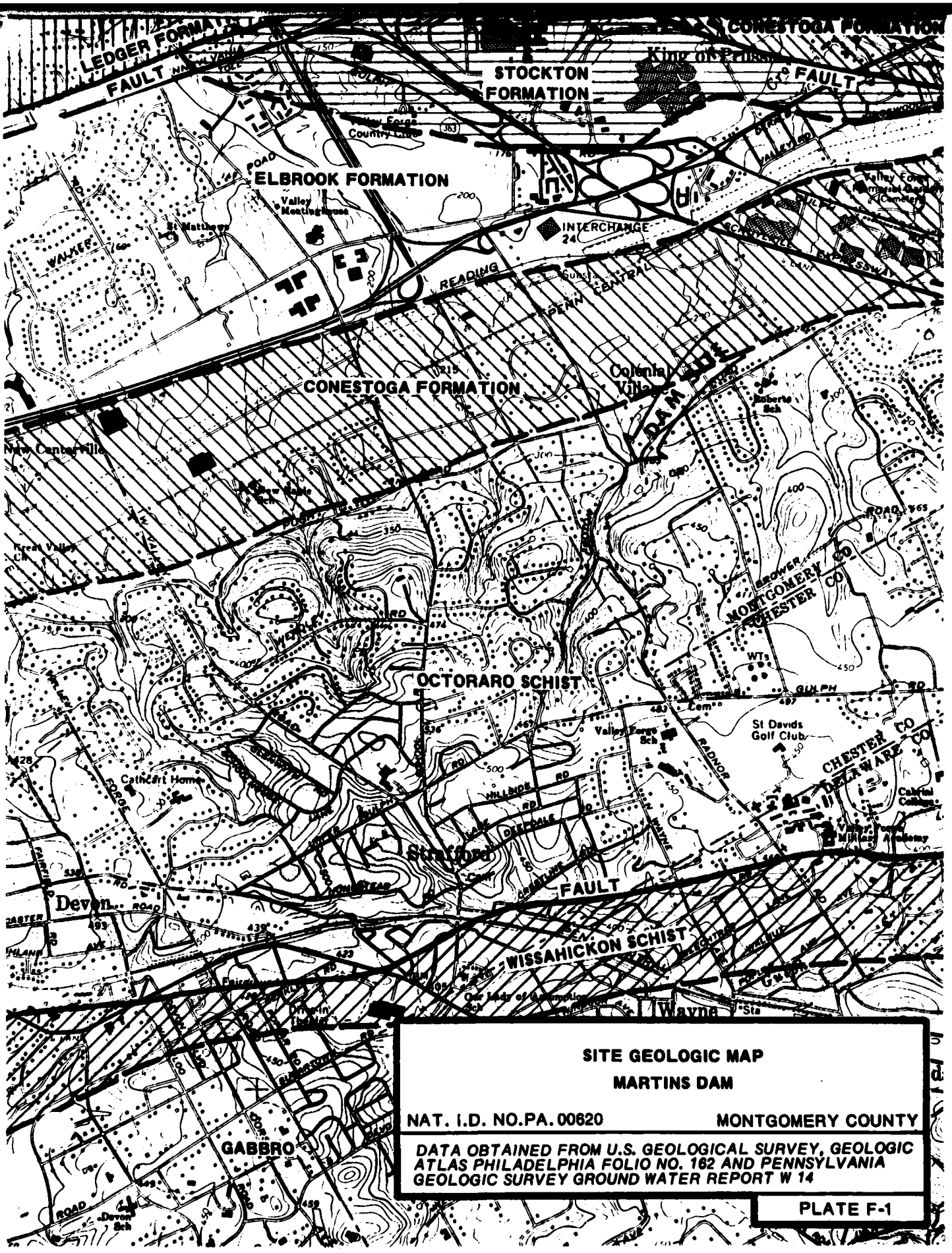
PLATE 3

APPENDIX

F

SITE GEOLOGY
MARTINS DAM

Martins Dam is located in the Piedmont Uplands Section of the Piedmont Physiographic Province. As shown in Plate F-1, the dam is underlain by the Octararo Schist of Lower Paleozoic age. Approximately 1,000 feet north of the dam lie the carbonate formations common to the Chester Valley. An area of bedrock is exposed in a parking lot upstream and immediately east of the dam. Here the foliation strikes east-northeast and dips 30 degrees to the south (upstream direction). High angle fractures striking north-northwest were also observed in this outcrop area. The massive, dense character of the bedrock and the upstream direction of foliation dip are favorable conditions to preclude seepage.



SITE GEOLOGIC MAP

MARTINS DAM

NAT. I.D. NO.PA. 00620 **MONTGOMERY COUNTY**

DATA OBTAINED FROM U.S. GEOLOGICAL SURVEY, GEOLOGIC ATLAS PHILADELPHIA FOLIO NO. 162 AND PENNSYLVANIA GEOLOGIC SURVEY GROUND WATER REPORT W 14

PLATE F-1